The Evolution of Dust and Small Planetesimals in Self-gravitating Protoplanetary Disks

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The formation of both terrestrial planets and the cores of gas/ice giant planets is thought to occur through the collisional accumulation of planetesimals. In the case of gas giant planets, a gaseous envelope is accreted if the core becomes sufficiently massive, a process that must occur while there is a still enough gas present in the circumstellar disk (within $\sim 10^7$ years). To form the planetary cores, however, requires the growth of planetesimals from, initially, micron-sized dust grains. For standard disk geometries, the drag force resulting from the different gas and dust velocities generally causes the dust to migrate towards the central star in a timescale shorter than the disk lifetime. We investigate here the evolution of dust and small planetesimals in a quasi-stable, self-gravitating disk. The resulting non-axisymmetric spiral structures can result in both inward and outward dust migration. We find that the particles that experience the largest radial drift may actually become trapped within the spiral structures and achieve densities that should significantly reduce their growth times. This has important implications for the growth of the cores of gas/ice planets and for the growth of terrestrial planets.